

# Analysis of Technology Cooperation Agreement Pilot Project Impacts

Wyatt Wilcox  
Department of Energy Pre-Service Teacher Program  
National Science Foundation  
Washington State University  
National Renewable Energy Laboratory  
Golden, Colorado, 80401

July 27, 2001

Prepared in partial fulfillment of the requirements of the Department of Energy Pre-Service Teacher Program under the direction of Jeannie Renné, of the Environmental Programs Department of the National Renewable Energy Laboratory in Golden, Colorado.

Participant:

---

Signature

Research Advisor:

---

Signature

Disclaimer:

This report was prepared as an account of work sponsored by an agency of the United States government. Neither the United States government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States government or any agency thereof.

## Table of Contents

Cover page	i
Table of contents	ii
Abstract	1
Introduction	2
Materials and Methods	3
Results	5
Discussion and Conclusions	8
Acknowledgements	10
References	11
Graphs and Tables	12

## **Abstract**

Analysis of Technology Cooperation Agreement Pilot Project Impacts. WYATT WILCOX (Washington State University, Pullman Washington, USA, 99163) Jeannie Renné (National Renewable Energy Laboratory, Golden, Colorado 80401).

The Technology Cooperation Agreement Pilot Project (TCAPP), initiated as a result of the United Nations Framework Convention on Climate Change (UNFCCC) Article 4.5, has been working to create sustainable markets for clean energy technologies in developing countries. Recent work by TCAPP staff at the National Renewable Energy Laboratory (NREL) has yielded quantifiable evidence towards the progress of the program. Most outstanding achievements include 20 actions to remove market barriers, facilitation of 13 clean energy business projects, engagement of 400 international business donors as well as 10 bilateral and multilateral donors, business investment of \$117 million, and greenhouse gas (GHG) emission reductions equivalent to 670,000 tons of carbon per year. Anticipated achievements by the year 2004 include leveraging over \$40 million dollars of donor support, \$135 million of investment by partners in clean energy technologies and carbon equivalent reductions of up to 774,000 tons of carbon per year. The support for current initiatives suggest that TCAPP will remain a leading model for international clean energy technology transfer.

## **Category:**

Do you wish this paper to be considered for publication in the DOE Undergraduate Research Journal?

**YES**

School Author Attends: Washington State University  
DOE National Laboratory Attended: National Renewable Energy Laboratory  
Mentor's Name: Jeannie Renné  
Phone: (303)384-7469  
e-mail Address: [jeannie\\_renne@nrel.gov](mailto:jeannie_renne@nrel.gov)

Presenter's Name: Wyatt Wilcox  
Mailing Address: 401 N. Georgia St.  
City/State/ZIP: Kennewick, Washington 99336  
Phone: (509)783-0841  
e-mail Address: [wyatt@wsu.edu](mailto:wyatt@wsu.edu)

## **Introduction**

In August of 1997 the Technology Cooperation Agreement Pilot Project (TCAPP) was initiated to address Article 4.5 of the United Nations Framework Convention on Climate Change (UNFCCC). UNFCCC Article 4.5 states, “The developed country partners... shall take all practicable steps to promote, facilitate and finance, as appropriate, the transfer of, or access to, environmentally sound technologies and know-how to other Parties, particularly developing country Parties, to enable them to implement the provisions of the Convention.” (UNEP, 1998).

The vision of TCAPP is to foster sustainable markets for clean energy technologies by addressing country specific goals. The program incorporates two phases to achieve success. In the initial phase of the project, Technology Cooperation Frameworks were developed in cooperation with local governments, investors and in-country teams to identify clean energy technologies most likely to achieve development goals as well as reduce greenhouse gas (GHG) emissions. Phase two of the program incorporates addressing and removing market barriers as well as facilitating private investment programs. Through these two phases, TCAPP aims to achieve its goals of cultivating private investment in technologies that reduce GHG emissions and meet development needs, engage support by international and host country donors, and establish a model for international technology transfer under Article 4.5 of the UNFCCC (NREL 1999).

Funding for the program is provided by the United States Department of Energy (USDOE), the United States Agency for International Development (USAID), and the

United States Environmental Protection Agency (USEPA). The implementation of TCAPP is led by the United States Government, in cooperation with participating countries, out of the National Renewable Energy Laboratory (NREL) in Golden, Colorado. At present, TCAPP has teams cooperating with Brazil, China, Egypt, Kazakhstan, Korea, Mexico, and the Philippines. TCAPP also cooperates with the Southern African Development Community through the Cooperative Technology Implementation Plan (CTIP) program.

There has been time, since the completion of Technology Cooperation Frameworks, for TCAPP to make progress towards its goals. This report attempts to address, in a comprehensive manner, the progress of TCAPP and the probable direction of its future. First, the TCAPP program in its initial three years of implementation are examined, followed by recent progress and developments, and finally future projections are made.

## **Materials and Methods**

There have been numerous reports produced by NREL for the USEPA, USAID, and USDOE documenting the progress of TCAPP over the past four years, though few have contained significant amounts of quantifiable data. A recent effort by team leads at NREL to quantify the program's achievements has produced a substantial amount of data pertaining to specific program objectives including: data on business investment, leveraged donor investment, GHG emission reductions, policy impacts and development impacts. The resulting *Summary of Impacts and Results of TCAPP and CTIP Activities* compiled by

NREL staff, in July of 2001, contains 63 pages of charts and graphs documenting the TCAPP program in detail.

An analysis of TCAPP achievement through November of 2000 was based on three reports produced by NREL during those dates: *Technology Cooperation Agreement Pilot Project: Status Report*, *Technology Cooperation Agreement Pilot Project: A Collaborative Model for Clean Energy Technology Transfer*, and *Update of Country Activities and Progress: Technology Cooperation Agreement Pilot Project and Southern African Project Supported by the Climate Technology Initiative*. These reports were compiled, examined and cross-referenced to determine areas of most significant progress prior to November 2000.

For analysis of TCAPP's growth and development since November 2000, information was gathered from internal memorandums, published reports and personal interviews with country team leads including project manager, Ron Benioff. Interpretation of the memos and reports was achieved through the assistance of Mr. Benioff and Jeannie Renné, who is currently the country lead for Mexico and Brazil operations.

Projecting the future of TCAPP involved creating a model based on prior accomplishments. The TCAPP program, to date, was examined and evaluated based on success rate of project implementation and efficiency, as well as its impact on international policy. Also considered in this model is project feasibility, proposed investment, and the influence of current clean energy technology initiatives.

## Results

In the first three years of TCAPP's operation, teams from the participating countries established Technology Cooperation Frameworks identifying and addressing priority technologies and market barriers (EPA, 1998; NREL 1999; NREL 2000). Following the creation of these frameworks the TCAPP program began the process of project facilitation and market barrier removal. As of November 2000, TCAPP had shown significant progress in both these categories with more than 20 actions to remove market barriers<sup>1</sup> and the facilitation of the development of 13 clean energy business projects. TCAPP also spawned the engagement of over 400 international business representatives and involvement of at least 10 bilateral and multilateral donors. Full implementation of the 13 clean energy technology projects, alone, could account for up to \$100 million of investment and the reduction of up to 200,000 tons of carbon equivalent GHG emissions per year, or 4 million tons of carbon over the lifetime of the projects (NREL, 2000).

Business investment, both realized and committed, by TCAPP and CTIP partners account for \$118 million of investment in clean energy technology as of June 2001 (see Figure 1a and 1b). Moreover, TCAPP- and CTIP-facilitated projects are responsible for realized or committed reductions of GHG emissions equivalent to 2.5 megatons of carbon dioxide per year and proposed activities may produce a reduction of an additional 50

---

<sup>1</sup> Market barriers include problems such as a lack of information about characteristics of certain technologies, preference towards traditional energy supplies, or apprehension about the infrastructure for support and maintenance of the technology (EIA, 1999). Actions to remove market barriers would include policy reform, business training, commercial pilot projects, educational programs, etc. (NREL, 1999).

megatons per year (Benioff, 2001a) (see figure 2a and 2b). These figures show an increase of the November 2000 estimates by more than 200%.

The TCAPP program has been recognized favorably at least thirty-three times during sessions of major international climate conventions, such as the Convention of the Parties (COP), and the Subsidiary Body for Scientific and Technological Advice (SBSTA) meetings, as well as various Climate Technology Initiative (CTI) workshops. At these meetings, leading energy and environment officials have declared TCAPP as a beneficial and/or productive model for clean energy technology transfer (Benioff, 2001a). In the same light, TCAPP is also recognized as the leading model for technology transfer under UNFCCC Article 4.5. TCAPP has become a major player in changing policy positions of all its partner countries, making large contributions towards an increased support for a market-based approach to technology transfer.

In conjunction with CTIP, TCAPP has also made large steps towards key development goals set forth by partner countries. TCAPP involvement has enhanced the in-country business capacity and is working towards reducing local air pollution in all of its partner countries. In all but two countries, it is estimated that TCAPP will be able to greatly improve economic performance in both the industrial and commercial sectors. In addition, several cooperating partners have experienced increased rural and community development, as well as improved agricultural production (Benioff, 2001a).

TCAPP has demonstrated the ability to persuade major financing organizations, such as the World Bank, to focus funding efforts on TCAPP related projects. As a result, TCAPP activities are leveraging over \$600,000 of donor investment towards the expansion of clean



energy markets (Benioff, 2001b). Establishing co-funding for market barrier removal programs and project facilitation by multi-lateral and bilateral donors has become an essential part of TCAPP's success.

Recent data obtained by NREL staff project the impact of the TCAPP program to be growing steadily. By 2004, it is estimated that the TCAPP program<sup>2</sup> will have access to up to \$40 million dollars to leverage towards increasing clean energy technology markets, and proposed expansion of TCAPP related projects could result in up to \$135 million of investment by TCAPP partners (Benioff, 2001b).

The growth of TCAPP has made initial oversights in the program structure more readily visible. In a meeting held at USAID in June of this year, a few dimensions of the program were identified as areas of concern. Of these, the program's objectives and the methods that it employs to measure progress were recognized as areas that lend themselves most readily to improvement (Chiu, 2001; Benioff 2001b). The current scope of the TCAPP program, which encompasses market barrier removal as well as project facilitation, lends itself poorly to quantitative assessment. Additionally, the vast numbers of partners and donors involved makes compiling accurate data over the breadth of the program a daunting task.

Despite some weaknesses of the program, TCAPP remains to be supported by partners and sponsors. Recent developments also suggest that there will continue to remain a niche for programs similar to TCAPP. Examples of supporting initiatives are The White House Initiative on Climate Technology, the Climate Technology Initiative, the Clean

Energy Technology Exports (CETE) initiative and the United Nations Development Program/Global Environment Facility (UNDP/GEF) technology transfer initiative who recognize the beneficial function of TCAPP. Additionally, an energy bill introduced by Senator Jeff Bingaman (D) in March demonstrates the continuing role of programs like TCAPP because TCAPP itself fulfills many of the objectives outlined for the proposed InterAgency Working Group assigned to address international clean energy technology transfer (Bingaman, 2001).

## **Discussion and Conclusions**

There seems to be a great potential for TCAPP's impact on international technology transfer to grow. According to the report *GEF Partners with Business for a Better World*, developing countries will require at least 5 million megawatts of electrical generating capacity in the next forty years (Global Environment Facility, 2001). If TCAPP helps to encourage the use of clean technology rather than traditional methods for electricity production, significant economic impacts might be realized. The same GEF report states that using renewable energy for just 3 percent of this capacity could produce as much as \$5 billion of investments per year. It is then plausible that far greater investments might be achieved if TCAPP, along with similar programs and initiatives, is able to seed the change from traditional to clean energy.

---

<sup>2</sup> Contributions by the Cooperative Technology Implementation Plan (CTIP) are included in year 2004 projections.

It is likely that support for TCAPP will continue in the future. The recent energy crisis in the United States has only highlighted the need for energy conservation and alternative energy sources on both the domestic and international fronts. In line with recent developments, the TCAPP program has initiated a retooling process to refocus itself on objectives that meet current needs<sup>3</sup>. With the strength of several initiatives supporting the need for international clean energy technology transfer and TCAPP's current status as one of the leading programs in that area, TCAPP can be expected to continue to provide substantial benefits to the renewable energy market and the development of its partner countries.

---

<sup>3</sup> The retooling process is attempting to clarify and/or redirect objectives as well as design a system of metrics allowing for greater quantification of accomplishment.

## **Acknowledgements**

Thank you to Jeannie Renné of the National Renewable Energy Laboratory for her assistance and guidance in the development of this report and for her willingness to take the role of my mentor for the duration of my stay at NREL. A special thanks also to Ron Benioff, TCAPP project manager, who provided access to much of the data used for the completion of this report, as well as his assistance in the development thereof. Thank you also to Dan Bilello, and the numerous individuals and team leads working with the TCAPP program.

I would also like to express my gratitude to Robi Robichaud, the Pre-Service Teacher (PST) Program Coordinator at NREL. His guidance and assistance throughout my internship were an invaluable and enjoyable part of the experience.

Ultimately, without the support of the United States Department of Energy, the National Renewable Energy Laboratory, and the National Science Foundation, this experience would not have been possible. Many thanks to the numerous individuals and the respective organizations that helped to make this experience possible.

## References

- Benioff, Ron. (2001a). Internal memorandum. *Summary of Impacts and Results of TCAPP and CTIP Activities: June 9, 2001*. National Renewable Energy Laboratory. Golden Colorado.
- Benioff, Ron (2001b). Internal memorandum. *TCAPP Review – Next Steps: In Preparation of Meeting on July 18<sup>th</sup> 2001*. National Renewable Energy Laboratory. Golden Colorado.
- Bingaman, Jeff. (2001). Introduced Bill. *Comprehensive and Balanced Energy Policy Act of 2001*. S 597 IS.
- Chiu, Kong. (2001). Internal Memorandum. *Meeting Notes*. Environmental Protection Agency.
- Energy Information Administration. (1999). *Analysis of the Climate Change Technology Initiative*. SR/OIAF/99-01. Washington DC: Energy Information Administration
- Environmental Protection Agency (1998). *Technology Cooperation Agreement Pilot Project: Status Report*. NREL/TP25795. Golden, CO: National Renewable Energy Laboratory.
- Global Environment Facility (GEF). (2001). *GEF Partners with Business for a Better World*. [http://www.gefweb.org/Whats\\_New/Archives/archives.html](http://www.gefweb.org/Whats_New/Archives/archives.html)
- National Renewable Energy Laboratory. (1999). *Technology Cooperation Agreement Pilot Project: A Collaborative Model for Clean Energy Technology Transfer*. BK-710-26841. Golden, CO: National Renewable Energy Laboratory.
- National Renewable Energy Laboratory. (2000). *Update of Country Activities and Progress: Technology Cooperation Agreement Pilot Project and the Southern African Project Supported by the Climate Technology Initiative*. NREL/MP-710-30103. Golden, CO: National Renewable Energy Laboratory.
- United Nations Environment Program. (1998). *UNFCCC: Convention on Climate Change*. UNEP/IUC/98/5. Switzerland: Information Unit for Conventions (IUC).

**Figure 1a.**

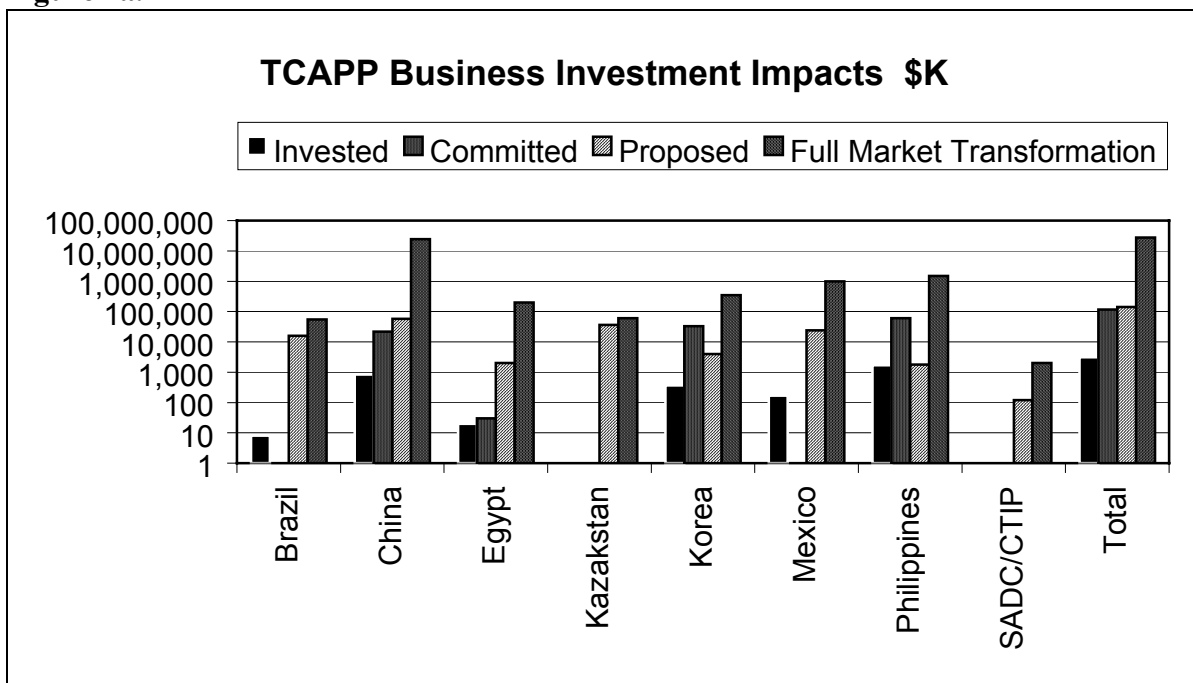


Figure 1a shows thousands of dollars invested, committed, or proposed for clean energy technology projects as a result of TCAPP involvement. Invested dollars refers to the actual expenditures to date. Committed dollars refer to expenditures likely to take place due to firm commitments by TCAPP partners. Proposed dollars refer to expenditures associated with proposed projects that have yet to receive firm commitment for development. Full Market transformation refers to the investment if industrial, commercial, and residential sectors are accounted for.

**Figure 1b.**

TCAPP Business Investment Impacts \$K				
Country	Invested	Committed	Proposed	Full Market Transformation
<b>Brazil</b>	8	N/A	16,000	55,000
<b>China</b>	840	22,000	57,000	24,500,000
<b>Egypt</b>	20	30	2,000	200,000
<b>Kazakhstan</b>	N/A	N/A	36,600	60,000
<b>Korea</b>	363	33,000	4,000	350,000
<b>Mexico</b>	170	N/A	24,000	1,000,000
<b>Philippines</b>	1700	60,000	1,800	1,500,000
<b>SADC/CTIP</b>	N/A	N/A	120	2,000
<b>Total</b>	3101	115,000	141,520	27,667,000

Figure 1b is the data table used to create the graph figure 1a. For purposes of summing totals, values designated as N/A are treated as zero.

**Figure 2a**

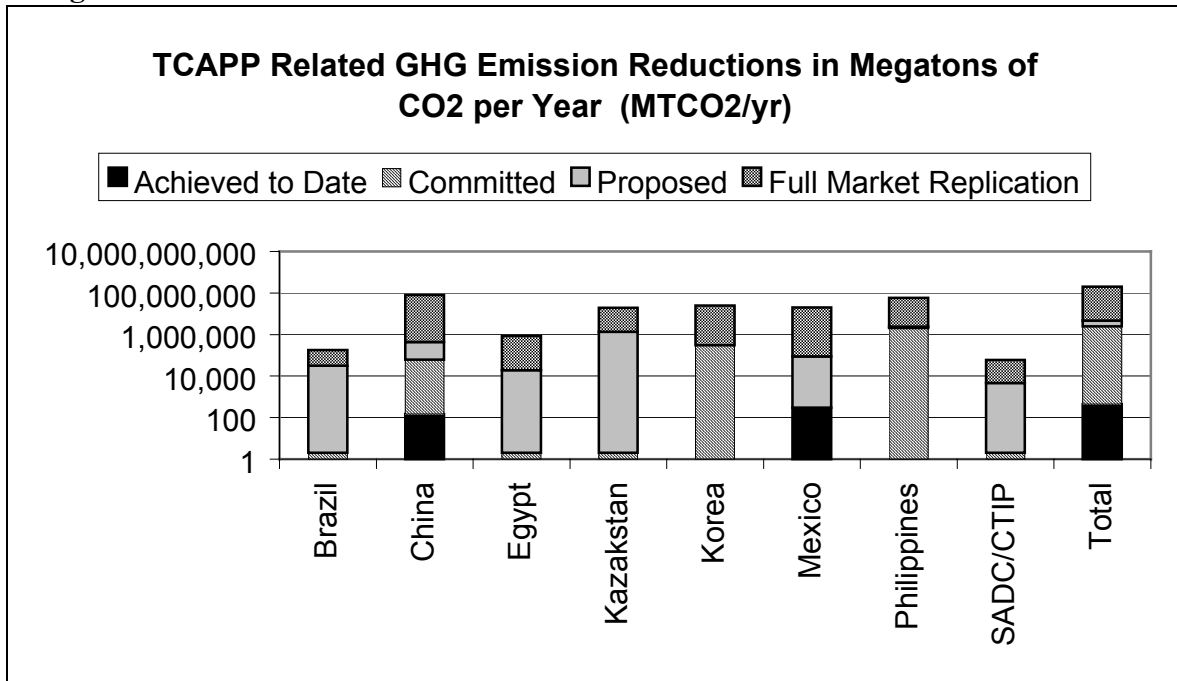


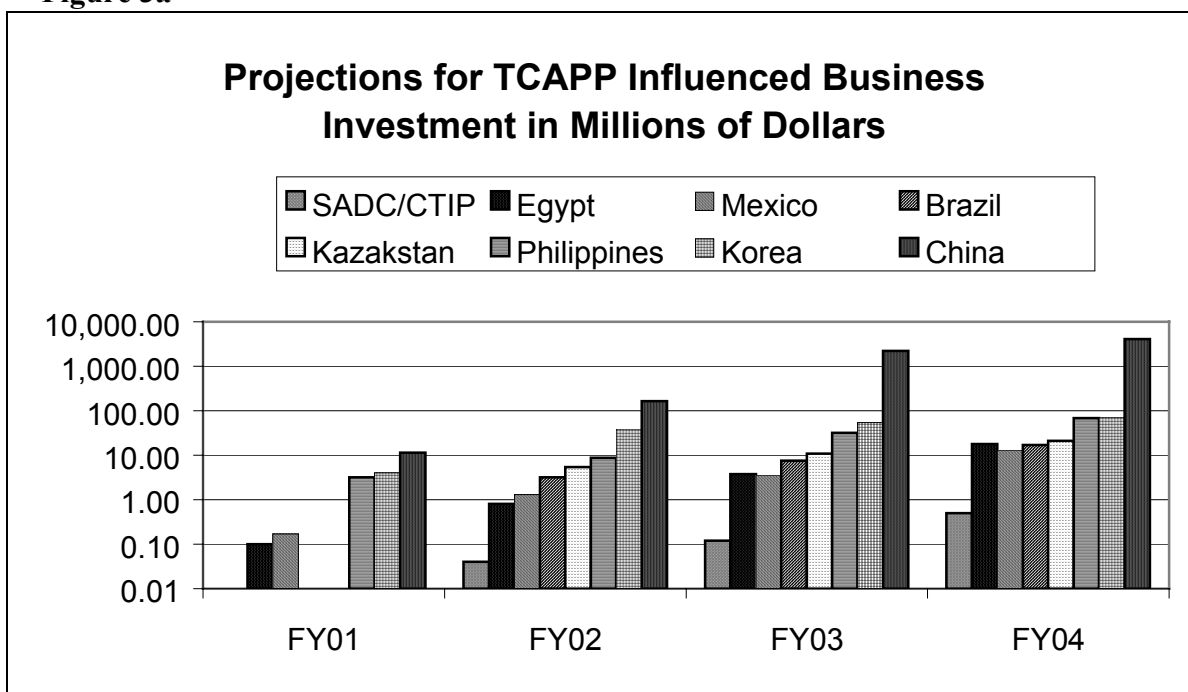
Figure 2a is the total TCAPP related greenhouse gas emission reductions by country. Units are thousands of tons of carbon equivalent per year. Achieved to date reductions refer to actual observed reductions as of June 2001. Committed reductions refer to those reductions likely to occur due to firm commitments by TCAPP partners. Proposed reductions refer to those reductions associated with proposed projects that have yet to receive firm commitment for development. Full Market transformation refers to the emission reductions if industrial, commercial, and residential sectors are accounted for.

**Figure 2b**

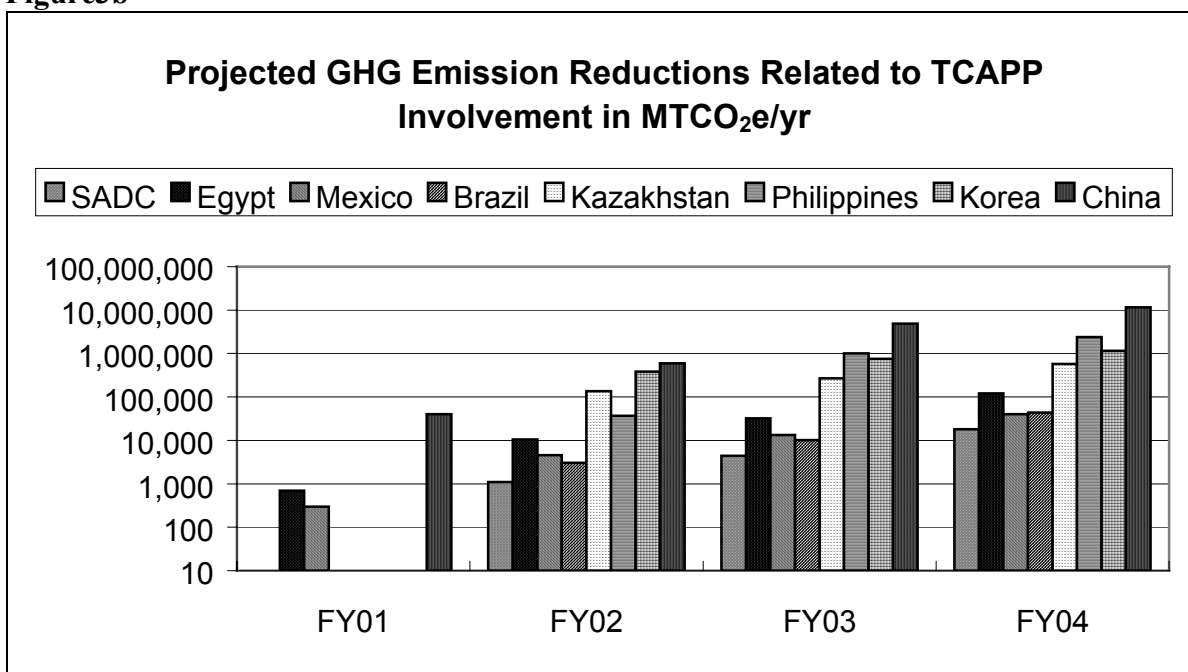
Country	Achieved to Date	Committed	Proposed	Full Market Transformation
<b>Brazil</b>	N/A	N/A	32,000	148,000
<b>China</b>	150	62,000	380,000	80,000,000
<b>Egypt</b>	N/A	N/A	19,000	848,000
<b>Kazakhstan</b>	N/A	N/A	1,350,000	17,800,000
<b>Korea</b>	N/A	310,000	N/A	25,000,000
<b>Mexico</b>	300	N/A	88,000	19,700,000
<b>Philippines</b>	N/A	2,100,000	284,000	56,700,000
<b>SADC/CTIP</b>	N/A	N/A	4,600	55,000
<b>Total</b>	<b>450</b>	<b>2,472,000</b>	<b>2,157,600</b>	<b>200,251,000</b>

Figure 2b is the data table used to create the graph figure 2a. For purposes of summing totals, values designated as N/A are treated as zero.

**Figure 3a**



**Figure3b**





**Figure 3c**

<b>Projections for TCAPP Influenced Investment in Millions of Dollars</b>				
Country	FY01	FY02	FY03	FY04
Brazil	< .01	3.2	7.5	17
China	11.5	164	2200	4100
Egypt	.1	.8	3.75	18
Kazakhstan	< .01	5.4	10.8	21.2
Korea	4	39	54	72
Mexico	.17	1.3	3.6	13
Philippines	3.21	8.81	31.81	68.81
SADC/CTIP	< .01	0.04	.12	.5
<b>Total</b>	18.98	222.55	2311.58	4310.51

Figure 2b is the data table used to create the graph figure 3a. For purposes of summing totals, values designated as <.01 are treated as zero.

**Figure 3d**

<b>Projections for TCAPP Related Greenhouse Gas Emission Reduction in MTCO<sub>2</sub>e/yr</b>				
Country	FY01	FY02	FY03	FY04
Brazil	N/A	3040	10200	44000
China	40000	600000	4900000	11500000
Egypt	700	10455	32300	119800
Kazakhstan	N/A	135000	267000	580000
Korea	N/A	384000	755000	1160000
Mexico	300	4580	13400	40000
Philippines	N/A	37000	1000000	2400000
SADC/CTIP	N/A	1100	4400	18000
<b>Total</b>	41000	1175175	6982300	15861800

Figure 3d is the data table used to create the graph figure 2a. For purposes of summing totals, values designated as N/A are treated as zero.